ELEC ENG 2EI4
Electronic Circuits

Project 2

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Test plans

For each non-ideality specified above, describe the experiment that you will use to determine the quantitative performance of your design. This includes:

i. Values that you will set for V control, V supply and and v1
ii. Values that you will measure.
iii. Values, if any, that you will calculate based on the measurement

Switch 1

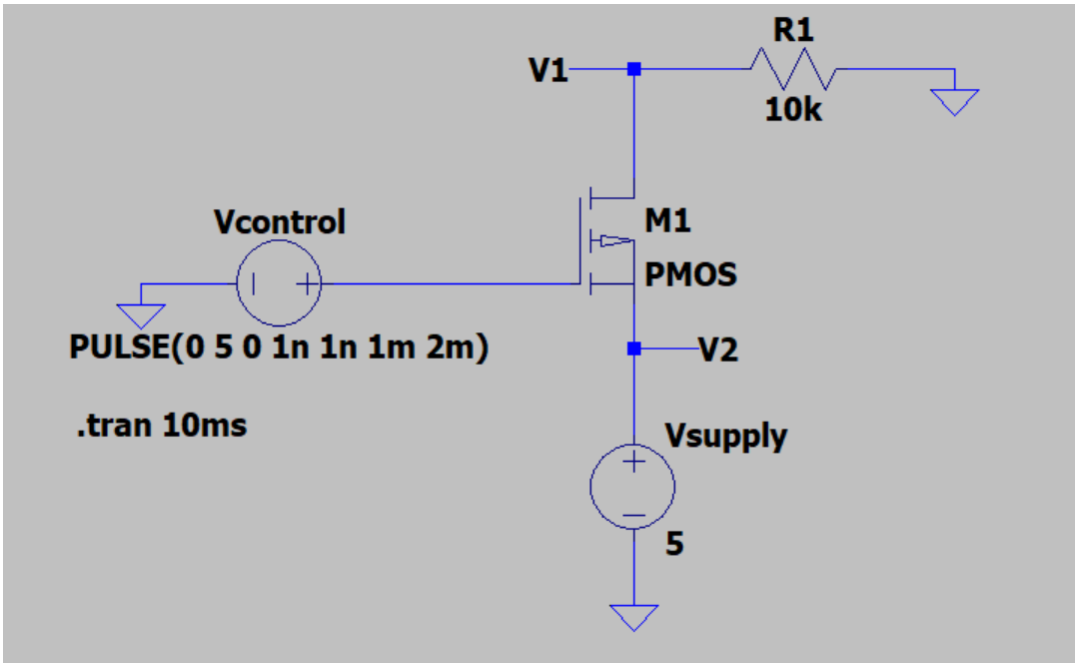
For the first switch, Vsupply will be set to a DC voltage of 5V, where V1 will also be equal to 5V to ensure saturation. To set Vcontrol, a square wave signal of 100Hz varying between 0-5V (amplitude and offset of 2.5V) will be used. Vcontrol and V1 will be plotted to ensure that the behaviour of the circuit is that of a switch's. A resistor value of 10k will be used to measure V1 based on the voltage drop across. Based on how the circuit is designed and values measured, no calculations are required based on the measurement.

Switch 2

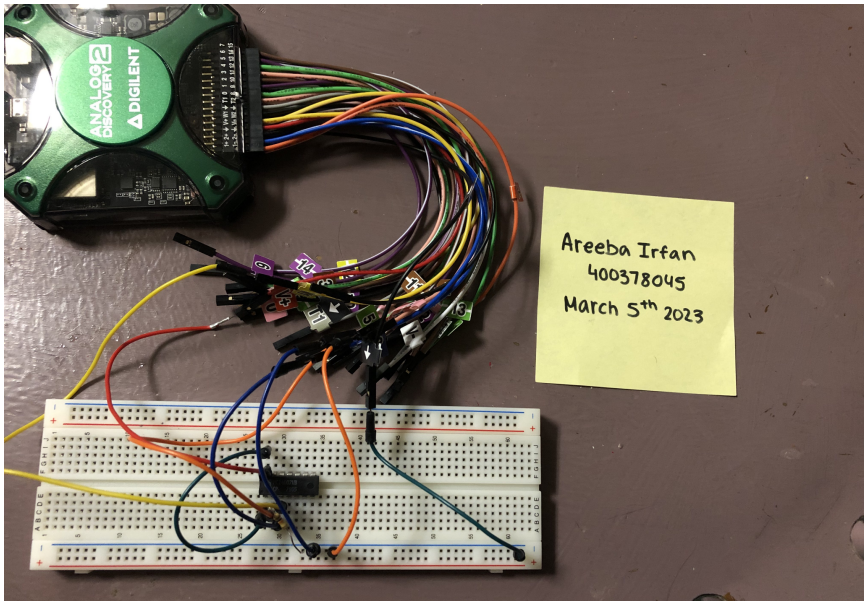
Switch 2's values were set and measured in a similar manner as switch 1. For this switch, Va and Vb will also be measured to ensure that V1 = Va as well as V1 = Vb.

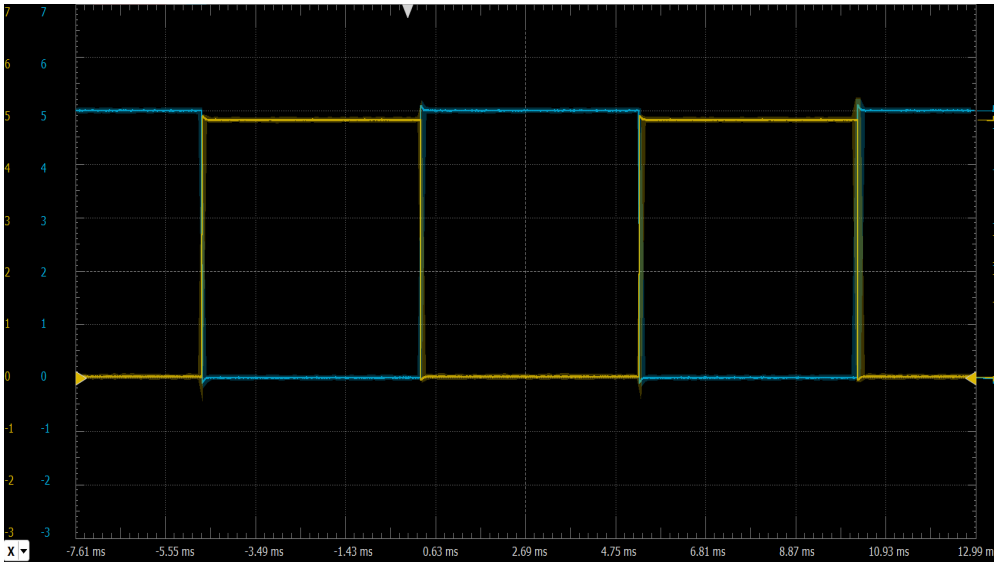
Switch 1

i. A circuit schematic of your design.



ii. Measurements performed according to the test plan.





The images above show the circuit built along with the values measured from the circuit using the Analog Discovery 2. The scope displays the behaviour of a switch. The yellow line shows the measurement of Vcontrol while the blue line shows the measurement of V1.

iii. Theoretical explanation for the results obtained and comparison of the quantitative results with theory.

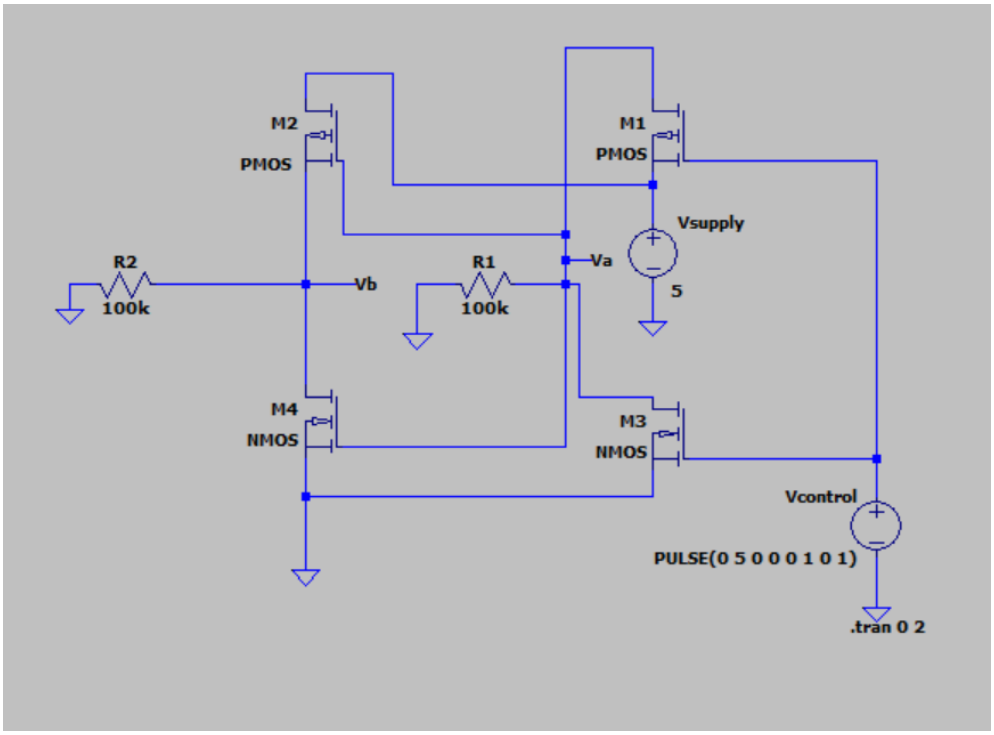
Theoretically, when Vcontrol is 0V, V1 should measure 5V and when Vcontrol is 5V, V1 should measure 0V. Based on the graph, it can be seen that this has been achieved, though a slight difference can be seen between the two plots. This could be due to the resistor value used to measure V1 or the MOSEFT's internal resistance and non idealities. The current values (i1 and i2) were also measured and were very close in value, which matches the theoretical claims. This is because when the switch is open, no current flows through the circuit so both i1 and i2 are equal to 0A, but when the switch is closed, the same current flows through the circuit, therefore i1 should equal i2.
These results are ideal for the design of a switch.

iv. Design tradeoffs. What tradeoffs did you make in your design for performance, complexity, and cost?

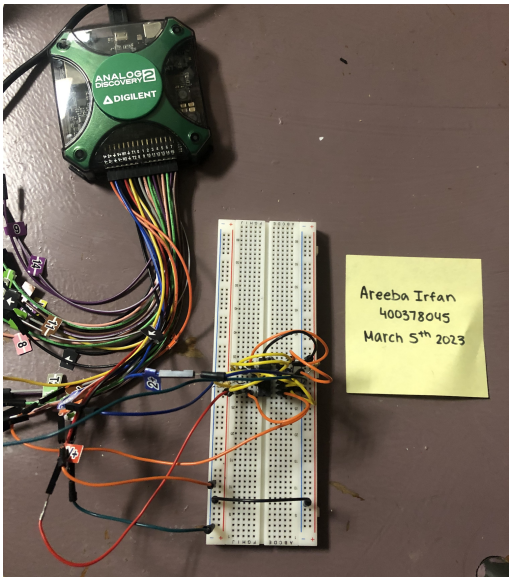
While the switch is fully functional, the ideality of a bidirectional switch was sacrificed because of the use of one mosfet, which lowers its performance and complexity. The advantage of using one mosfet is that it is less expensive and cheaper to manufacture.

Switch 2

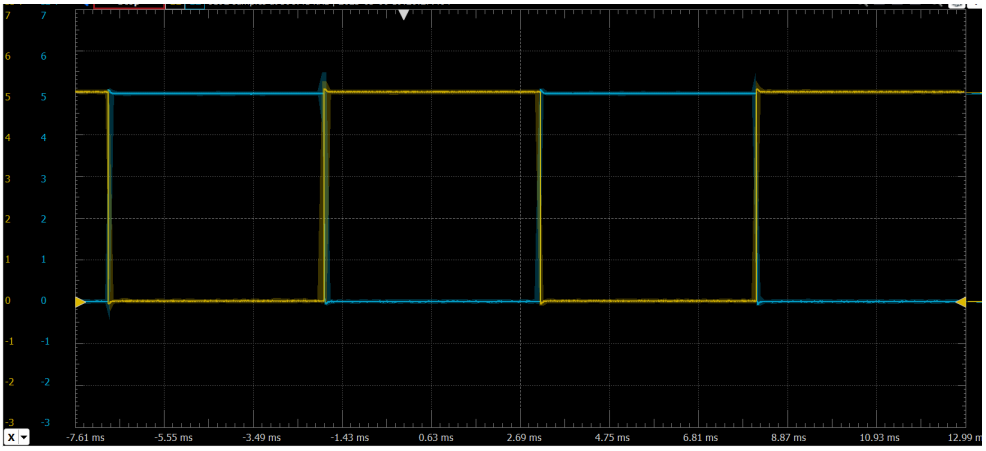
i. A circuit schematic of your design.



Ii. Measurements performed according to the test plan.

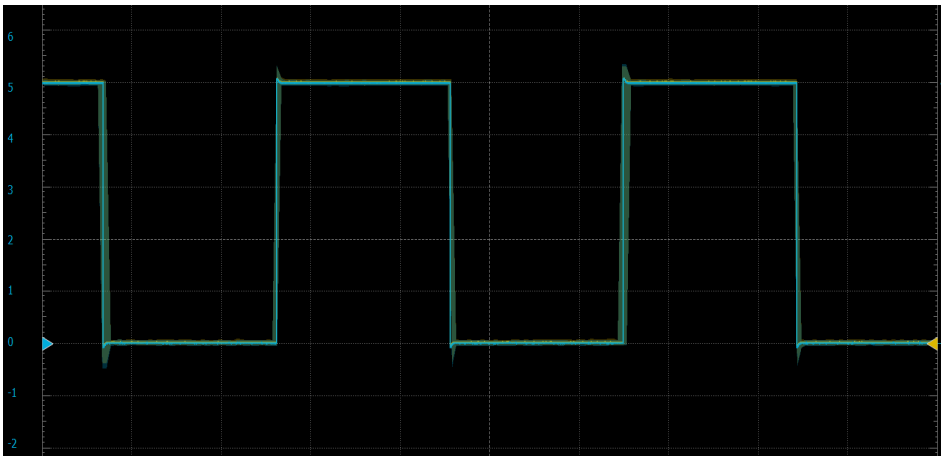


Scope output for Vcontrol and Va



The images above show the circuit built along with the values measured from the circuit using the Analog Discovery 2. The scope displays the behaviour of a switch. The yellow line shows the measurement of Vcontrol while the blue line shows the measurement of Va.

Scope output for Vcontrol and Vb



The images above show the circuit built along with the values measured from the circuit using the Analog Discovery 2. The scope displays the behaviour of a switch. Though it is a bit difficult to see, the yellow line (Vcontrol) and blue line (Vb) overlap.

iii. Theoretical explanation for the results obtained and comparison of the quantitative results with theory.

In theory, when Vcontrol is equal to 0V, Va should be equal to 5V and when Vcontrol is equal to 5V, Va should be equal to 0V. As for Vb, the plot should follow the same as Vcontrol's. Based on the graphs obtained, it can be seen that these results have matched the theoretical expectations. It can be seen that the graphs match more than they did in switch 1, this could be because a higher resistance value (100k) was used to test the switch.

iv. Design tradeoffs. What tradeoffs did you make in your design for performance, complexity, and cost?

Once again, simplicity and cost were prioritized for this switch as they are easier to build and manufacture. The tradeoff to this once again is that performance and complexity are sacrificed and these circuits may not be ideal for many applications.